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Fact Sheet

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FIBER-REINFORCED CERAMIC MATRIX COMPOSITE MATERIAL (CERHAB)

The Problem

Using polymeric and metallic coatings to rehabilitate metallic components damaged by corrosion, cavitation, and erosion can be problematic. Polymeric organic coatings, such as vinyls, exhibit low erosion and corrosion resistance. The U.S. Environmental Protection Agency requires that the use of volatile organic compounds be reduced. In addition, lead oxide-based paints have been widely used as primers for polymeric coatings and are now considered hazardous waste. Removal and disposal of the coatings require the use of special equipment and procedures, increasing the cost of surface preparation by two to three times over non-lead-based coating systems.

Metallic coatings, such as zinc, aluminum, brass, and stainless steels, are applied by fusion processes, such as welding or thermal spraying. Production rates, however, are quite low and polymeric sealants must be added. Stainless steels, aluminum, or brass coatings can cause galvanic corrosion problems.

The Technology

Research at the U.S. Army Construction Engineering Research Laboratory (CERL) focuses on the investigation of a fiber-reinforced ceramic matrix composite material (CERHAB) to repair metallic components damaged by corrosion, cavitation, and erosion. The material's cavitation and erosion resistance were tested in the laboratory and compared to a commonly used fiber-reinforced epoxy. Several application methods were studied, including furnace coating, microwave dip coating, and laboratory flame spray techniques. Field-application would require the use of basic flame spray techniques.

If the structure is allowed to cool rapidly, the thermal stresses developed in the glass make the CERHAB brittle and the pieces fall off. However, it has been shown that if the structure is cooled slowly by heaters or annealed in a furnace, the CERHAB enamel can stay on as a coating. The use of portable heater for the field application of CERHAB coatings would permit the field repair of pumps, turbines and other components. The use of the CERHAB as a seal coating on thermally sprayed metal coatings is also being investigated.

Benefits/Savings

Using CERHAB as a repair material increases resistance to cavitation and erosion when compared to the commonly used fiber-reinforced epoxies. Chemical bonding in the CERHAB enamel is stronger than the mechanical interlocking exhibited in epoxy repair materials. The CERHAB composite is an improved alternative over the commonly used reinforced epoxy. It exhibits strong, gap-free chemical bonding with the metallic substrate taking oxides into solution, safely pulling them away from the interface.

Status

The use of portable heater for the field application of CERHAB coatings to permit the field repair of pumps, turbines and other components is under development. The use of CERHAB as a seal coat on thermally sprayed metal coatings is also being investigated.

Point of Contact

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